

Attachment 2
Findings Regarding Clean Water Act Section 316(b)
Modernized Morro Bay Power Plant
NPDES Permit Order RB3-2004-0028

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APPLICABLE LAW *[This section will be revised as needed to reflect applicable final regulations promulgated before the Regional Board adopts the permit.]*

Section 316(b) states:

“Any standard established pursuant to section 1311 of this title or section 1316 of this title and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.”

The United States Environmental Protection Agency (EPA) adopted regulations interpreting section 316(b) in 1976, but they were invalidated on procedural grounds. EPA did not attempt to adopt regulations again until the 1990’s. In December 2001, EPA issued final 316(b) regulations that apply only to new facilities (66 Fed. Reg. 65256, 40 C.F.R. Part 125, Subpart I.) These regulations do not apply to MBPP. In April 2002, EPA issued proposed regulations that would apply to existing facilities, including MBPP, but EPA does not plan to issue final regulations until February 2004. (67 Fed. Reg. 17122.) Although the draft regulations for existing facilities do not apply to this proceeding, they represent EPA’s most recent analysis of section 316(b). The Federal Register preambles to the final and draft regulations are also useful for the same reason.

EPA has directed:

“Until the Agency promulgates final regulations... Directors should continue to make section 316(b) determinations with respect to existing facilities, which may be more or less stringent than today’s proposal on a case-by-case basis applying best professional judgment.” (67 Fed. Reg. 17124 col. 3.)

EPA advised that an EPA 1977 draft guidance on section 316(b) still applies to existing facilities pending adoption of final regulations. (67 Fed. Reg. 17125, col. 1.) The draft guidance is entitled, *Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment; Section 316(b) (May 1, 1977) (1977 Draft Guidance)*.

The legal standards applied here are based on an analysis of EPA administrative decisions, opinions, the 1977 draft guidance, federal court opinions and reference to the final 316(b) regulations for new facilities, the draft regulations for existing facilities and their preambles in the Federal Register.

There are four basic steps in a Best Technology Available (BTA) analysis:

- 1) Determine whether the facility's cooling water intake structure may result in adverse environmental impact;
- 2) if so, what alternative technologies involving location, design, construction and capacity of the cooling water intake structure can minimize adverse environmental impact;
- 3) determine whether alternate technologies are available to minimize the adverse environmental impacts; and
- 4) whether the costs of available technologies are wholly disproportionate to the environmental benefits conferred by such measures.

The following legal principles were applied in the Board's 316(b) analysis:

- Adverse environmental impacts occur whenever there will be entrainment or impingement damage as a result of the operation of a specific cooling water intake structure.
- Minimize does not mean to completely eliminate adverse impacts. New regulations define minimize to mean to reduce to the smallest amount, extent, or degree reasonably possible. EPA also views increases in fish and shellfish as an acceptable alternative to reduction in entrainment.
- Alternatives that must be considered are location, design, construction and capacity of cooling water intake structures that minimize adverse environmental impacts.
- Although closed-cycle cooling systems are not cooling water intake structures they can be required indirectly by limiting the capacity (cooling water flow) of the intake structure.
- A determination on whether a technology is "available" could be made on any number of grounds based on site-specific conditions. The 1977 Draft Guidance states,

"It is accepted that closed cycle cooling is not necessarily the best technology available, despite the dramatic reduction in rates of water used. The appropriate technology is best determined after careful evaluation of the specific aspects at each site." (1977 Draft Guidance p. 12.)
- The standards for determining whether the costs of a technology are wholly disproportionate to the environmental benefit conferred by such measures are set forth in findings below.

SUMMARY OF CONCLUSIONS

- Because of limited legal authority interpreting Clean Water Act Section 316(b), which addresses entrainment and impingement impacts, the Board must exercise its best professional judgment to reach a reasonable conclusion based on site-specific conditions.
- Impingement of adult and juvenile fish on the traveling screens within the intake structure at the existing MBPP is not significant. The modernized MBPP will use less cooling water, which should act to reduce impingement losses. Accordingly, no additional alternative technologies are necessary to further reduce impingement at MBPP, and the cost of any additional impingement reduction technology would be wholly disproportionate to the benefit to be gained. /
- Entrainment of smaller organisms (like fish larvae) occurs in once-through cooling water systems. Entrainment losses at MBPP are significant and represent an adverse impact. However, the technologies that may reduce entrainment at MBPP are either experimental (screens and filters) or are not available for use at this site (closed cooling systems such as saltwater cooling towers, dry cooling, or hybrid systems).
- Regardless of availability or feasibility, the cost estimates for closed cooling systems at MBPP are wholly disproportionate to the benefit to be gained. The cost estimate range for the cheapest closed cooling system (salt water cooling towers) is \$28 million to \$165 million. The cost estimate range for the most expensive system (dry cooling) is \$105 million to \$260 million. The benefits to be gained from closed cooling are expressed as acre-years of estuarine habitat productivity (larval productivity and overall productivity). These benefits are compared to acres-years of habitat productivity that could be obtained from other actions such as sedimentation control (although there is a significant time differential for realized benefits). Duke Energy has proposed a Habitat Enhancement Program fund of \$12.5 million as part of the modernization project, which allows for a benefit that can be compared to the benefits of alternative methods of cooling.
- The California Energy Commission's Revised Presiding Members Proposed Decision (PMPD) for the MBPP is the "functionally equivalent" document pursuant to the California Environmental Quality Act (CEQA). The PMPD concludes that there will be no CEQA level impact associated with the once-through cooling water system (including impingement, entrainment, and thermal effects) for the modernized Power Plant, and therefore no alternatives to the once-through cooling water system can be required pursuant to CEQA. Nevertheless, the PMPD also evaluates the feasibility of closed cooling systems and concludes these systems are not feasible at Morro Bay due to noise, visual, land use, legal, and cost issues. Therefore the Regional Board cannot conclude that these systems are available at MBPP under the meaning of Section 316(b) of the Clean Water Act, which requires best technology "available."
- Porter Cologne Water Quality Control Act, Section 13142.5, states: For each *new or expanded* coastal power plant ... using seawater for cooling ..., the best available site, design, technology, and mitigation measures feasible shall be used to minimize the intake and mortality of all forms of marine life. The cooling water intake structure and Habitat Enhancement Program constitute the best available site, design, technology, and mitigation measures feasible to minimize the intake and mortality of all forms of marine life.

- Considering the proposed project with the \$12.5 million Habitat Enhancement Program fund, the cooling water intake structure for the modernized Power Plant is best technology available under Clean Water Act section 316(b) and the “wholly disproportionate cost” test. Therefore, no changes to the proposed cooling water intake structure location, construction, or design are required by this Order. However, this Order (Order R3-2004-0028) requires minimization of cooling water flows as described in Provisions 8 and 9, and minimization of intake velocities as described in Provisions 10.

DETAILED ANALYSIS

Under the direction of the Executive Officer, a technical workgroup was formed to oversee entrainment and impingement studies at MBPP for this NPDES permit. Workgroup members included Regional Board staff and independent scientists, the Discharger’s staff and consultants, California Department of Fish and Game staff, and Energy Commission staff. Currently, the Regional Board’s independent scientists on this project are Dr. Greg Cailliet, Moss Landing Marine Laboratories, and Dr. Pete Raimondi, UC Santa Cruz. These scientists are independent from, and have never worked for, the Discharger. Dr. Cailliet and Dr. Raimondi have extensive experience as independent scientists on several power plant projects in California.

Dr. Cailliet is a professor of ichthyology, marine ecology, population biology, and fisheries biology, with main interests in community and population ecology, biological oceanography, marine plankton and nekton, and estuarine ecology.

Dr. Raimondi is a professor of ecology and evolutionary biology whose research emphasizes nearshore marine communities. He also has substantial experience on the design, evaluation and analysis of marine monitoring programs, with particular expertise on the evaluation of marine discharges. Dr. Raimondi is currently directing the largest intertidal monitoring program in the world (through the Partnership for Interdisciplinary Studies of Coastal Oceans, or PISCO).

The workgroup reviewed and approved each element of the study, as well as the final report. Elements of the study included review and assessment of target organisms, sampling locations, sampling methods, larval identification, and data analysis and presentation.

Entrainment and Impingement

Duke Energy submitted its *Morro Bay Power Plant Modernization Project 316b Resource Assessment Report* on July 10, 2001. The 316b Demonstration includes an overview of the report process, a description of the results, and an evaluation of alternative technologies to minimize entrainment and impingement. The entrainment and impingement study results are also discussed in Regional Board staff’s testimony for this Order.

The purpose of the 316(b) Demonstration study at MBPP was to 1) estimate the number of larvae lost due to the power plant, 2) convert the larval loss to theoretical numbers of adult fish, and 3) estimate the proportion of larvae lost relative to the amount of larvae available in species-specific source water bodies, and 4) estimate impingement losses.

Entrainment

Duke Energy consultants, Tenera, conducted entrainment studies at MBPP for approximately twelve months under the direction of the Regional Board’s independent scientists and the technical workgroup. In addition to entrainment sampling in front of the intake structure, the study included sampling in the Morro Bay National Estuary and just outside the Estuary in Estero Bay.

The study used three methods to analyze the data:

1. Empirical Transport Model, or ETM
2. Fecundity hindcasting, or FH
3. Adult Equivalent Loss, or AEL.

Each of these methods has advantages and disadvantages as described in the 316(b) Demonstration report.

The ETM approach estimates the proportion of larvae lost relative to the amount of larvae available in a given source water body. Source water bodies are different for different taxa, such as estuarine taxa and coastal taxa. The source water body for estuarine taxa is the Morro Bay Estuary. The source water bodies for coastal taxa vary by species based on the age of entrained larvae and ocean current speed.

The FH and AEL approaches convert larvae to adults using survivorship curves and fecundity estimates. The major limiting factor with the FH and AEL approaches, and most fishery impact assessments, is our lack of knowledge about survivorship and fecundity. The lack of available life history information for most species requires us to make assumptions to fill in the gaps. Results from the FH and AEL approaches have very large statistical errors, so there is a great deal of uncertainty associated with these methods. The assumptions used to parameterize the FH, AEL, and ETM approaches were based on literature and the best professional judgment of the technical workgroup members. Staff and the Regional Board's independent scientists believe that ETM approach is the most rigorous, robust, and defensible of the three methods. Proportional larval losses based on the ETM approach are discussed below.

The 316(b) report calculates proportional larval losses for select estuarine and coastal taxa. Although the definition of entrainment includes all life stages of fish and shellfish, at MBPP, only larval stages are entrained. "Proportional larval loss" is the number of larvae entrained relative to the number of larvae considered to be at risk (i.e. in a source water body). Larvae are generally at risk of being entrained for a brief period in their developmental stages when they are suspended in the water column (up to several days). Different species are entrained at different rates; possible reasons for this are swimming ability, behavior, and location at birth. The amount of larvae lost to entrainment is directly related to the once-through cooling water flow rate. The following proportional larval losses are from Duke Energy's 316(b) report and are based on a flow rate 413 MGD. This flow rate was chosen by Discharger's consultant as a maximum value under normal operating conditions. This Order includes a maximum permitted flow rate of 475 MGD, and an annual daily-average flow rate of 370 MGD (proposed by Discharger). It is understood that higher flow rates result in greater entrainment losses, and visa versa. Based on the annual daily-average flow limit in this Order, the results below overstate the entrainment losses, and are therefore considered a conservative estimate of losses (erring on the side of resource protection).

The following proportional larval losses are for taxa that spawn in the Morro Bay Estuary, based on maximum larval duration:

Unidentified Gobies:	43%
Shadow Gobies:	6.2%
Jacksmelt:	44%
Combtooth Blennies:	72%
Pacific Herring:	2%

Simple Average: 33%

The following proportional larval loss values are for coastal taxa (non-estuarine taxa):

Staghorn Sculpin:	5%
Northern Lampfish:	2%
Rockfishes:	2%
White Croaker:	2%
<u>Cabazon:</u>	<u>4%</u>

Simple Average: 3%

The following proportional loss values are for larval invertebrates:

Brown Rock Crabs:	3%
Hairy Rock Crabs:	0.8%
Yellow Rock Crabs:	3%
Slender Crab:	0.8%
Red Rock Crab:	2%
<u>Dungeness Crab:</u>	<u>5%</u>

Simple Average: 3%

Duke Energy considers the best overall estimate of larval loss to be approximately 10% based on averaging estuarine and coastal taxa together, using the mean larval age for all taxa, and using weighted averages. Therefore, the larval loss estimates before the Regional Board range from approximately 10% (Duke Energy's estimate) to 33% (Regional Board staff and independent scientists estimate). These two values are used throughout this analysis.

The fish and invertebrates listed above were the most abundant taxa in the samples collected. The composition and abundance of taxa collected are determined by sampling methodology. For example, a sampling net with a finer mesh would have collected more species but would have clogged easily and been impractical for sampling very large volumes of water. This subset of taxa is therefore intended to represent the hundreds of larval species actually entrained. The main purpose of the 316(b) study was to determine if the once-through cooling system entrains large proportions of larvae from the Estuary. The results indicate that proportional larval loss is high enough to require consideration of alternative technologies to reduce entrainment. When the flow rate is 413 MGD, and using maximum larval duration in the equations, the modernized Power Plant will entrain 33% of the larvae from those estuarine taxa that are at risk of entrainment (many more species are not at risk of being entrained). The design (maximum) flow rate for the modernized Power Plant is 475 MGD. The annual daily-average flow limit per this Order is 370 MGD. Proportional larval losses will be lower than 33% on an annual daily-average basis due to the annual daily-average flow rate limit of 370 MGD.

The proportional larval loss caused by the modernized Power Plant may result in population or community level impacts in the Morro Bay Estuary, or the maintenance of impacts caused by the existing Power Plant (although such impacts have never been determined). The problem is determining "cause and effect" with respect to biological changes. It is very difficult if not impossible to detect population and community level impacts caused by a particular source such as a power plant, especially when there have been no baseline (pre power plant) studies and multiple stresses may contributing to potential biological changes. The existing Morro Bay Power Plant began operation in the 1950's, before environmental laws were enacted. The multiple stressors on Morro Bay include loss of physical habitat due to accelerated sedimentation, and pollutants such as nitrates, metals, pathogens, and pesticides.

There are four possible scenarios with respect to larval productivity impacts in the estuary due to entrainment, as follows:

4. There has been no change in estuarine larval productivity due to entrainment.
5. There has been a steady decline in estuarine larval production over time due to entrainment.
6. A lower equilibrium level of larval production was caused by operation of the existing Power Plant and will be maintained by continued entrainment.
7. With a reduced cooling water flow in the future, impacts (two and three above) will decrease over time.

From a resource protection point of view, the Regional Board assumes that the first scenario is not true. Further, the available evidence and best professional judgment of the independent scientists does not indicate declining larval productivity over time (the second scenario). If larval productivity were in steady decline due to entrainment, larval productivity may have crashed after fifty years of power plant operation. The entrainment study demonstrates that this is not the case. The available evidence and best professional judgment indicates that the impact of entrainment is most likely to result in lower but fairly stable larval productivity in the Estuary (lower larval productivity than would exist without the entrainment). This is a critical conclusion. If entrainment were causing a steadily declining condition in the Estuary, the Regional Board would consider the impact to be more significant.

USEPA considers estuaries to be among the most sensitive ecological habitats (316(b) Guidance Document, 316(b) regulations for new facilities, and draft 316(b) regulations for existing facilities). Moreover, the Morro Bay Estuary has been designated a State and National Estuary, designations that warrant the utmost protection for the resources of the Estuary. Therefore, Regional Board finds that the magnitude of proportional larval loss is an adverse impact on the Morro Bay Estuary. However, it is also evident from the empirical data of the 316(b) study that the Morro Bay Estuary continues to support hundreds of species of fish and invertebrates after fifty years of Power Plant operation, and hence there is no evidence that the Power Plant causes increasing larval productivity loss over time (a declining condition over time).

There are uncertainties in this entrainment study (and all other entrainment studies) because several assumptions are made in the data analysis, and the sampling results are highly variable. The major assumptions include:

1. That adequate sampling was done to estimate larval densities in the field.
2. That simple ocean current measurements can be used to estimate the size of source water bodies for coastal taxa.
3. That 100% of entrained larvae are killed.
4. That the ecological system does not respond and make up for the entrainment losses (compensation).

The entrainment results should be considered within the context of the uncertainties, however, the results are the best estimates of the technical workgroup, and are accepted by this Regional Board.

In conclusion, the available data does not indicate a declining condition over time due to entrainment. However, the relatively large proportional larval losses for estuarine taxa represent an adverse impact because the larval loss itself, regardless of any resulting population or community level affect, is a loss of resources.

Impingement: The once-through cooling water system for the modernized Power Plant will also cause impingement of adult fish and invertebrates on the traveling screens in front of the intake structure. Duke Energy's 316(b) report includes the results of an impingement study on the existing Power Plant to estimate future impingement rates for the modernized Power Plant.

Based on this study, the modernized Power Plant will impinge approximately 2,800 pounds of fish and about 800 pounds of invertebrates per year. The impingement study was conducted for one year to quantify the number of juvenile and adult fish trapped on the traveling screens. Over one hundred fish taxa were identified and counted in the impingement study. Of these, five taxa comprised the top 90% impinged by number, and seven taxa comprised the top 90% by mass. The most abundantly entrained fish by number and mass were northern anchovy. Northern anchovy comprised 74% of the total fish impinged by number, followed by topsmelt (6%), plainfin midshipman (5%), speckled sanddab (3%), and Pacific staghorn sculpin (2%). The other 95+ taxa comprised the remaining 10% of fish impinged.

These 2001 study results were compared to a previous impingement study conducted in 1978. The 2001 study collected a total of 11,000 fishes over a twelve-month period, while the 1978 study collected a total of 17,000 fishes over a twelve-month period. Although several of the most abundant taxa collected in the 2001 study are similar to the abundant taxa in the 1978 study, abundance of shiner perch and bocaccio are significantly less in the 2001 study. Over 1,100 bocaccio were collected during the 1978 study, and only two were collected during the 2001 study. This is expected because the 1978 results for bocaccio reflect a recruitment event that occurred in 1978. Bocaccio recruitment events occur about every eight to ten years. Also, the bocaccio population along the West Coast has declined significantly over the past decade, and management measures are in effect to regulate the take of this species. The 1978 study collected 5,400 shiner perch, while the new study collected only 45 shiner perch. There has also been a general decline in shiner perch in estuaries along the West Coast over the past several years. The differences between the impingement studies do not indicate impacts due to the Power Plant.

For comparison, the Huntington Beach Power Plant, with flow volumes similar to MBPP, and with an offshore intake structure, impinges up to 21 tons of fish per year. The El Segundo Power Plant, also with flow volumes similar to MBPP, and using an offshore intake, impinges about 15 tons of fish per year. Both of the offshore intakes noted above are about 2000 feet offshore in about 35 feet of water. The amount of fish impinged at MBPP is about 1.4 tons per year.

The permitted flow limit for the modernized Power Plant (475 MGD) is significantly less than the flow limit for the existing Power Plant (668 MGD), which will act to decrease impingement losses. Provision 8 of this Order requires Duke Energy to evaluate the cooling water flow reductions provided by variable speed pumps versus fixed speed pumps, and to install the most efficient type of pump if there is a significant difference (ten percent or greater). Also, Provision 9 requires Duke Energy to minimize cooling water flows by managing pump operation and effluent temperatures (maintaining effluent temperatures near permit levels). Finally, Provision 10 requires Duke Energy to periodically dredge the area in front of the intake structures to minimize intake structure approach velocities, which may help reduce impingement rates. These Provisions will act to minimize impingement losses.

Alternative Technologies

Since impingement losses are not significant at MBPP, only technologies that may reduce entrainment are relevant to this analysis. There are two potential ways of addressing entrainment losses:

1. Intake Structure Technologies
 - a. Screening or filtering systems

- b. Changing the intake location
- 2. Reduced Cooling Water Volume Withdrawal
 - a. Variable speed pumps
 - b. Seasonal flow limitations
 - c. Closed cooling systems (cooling towers, dry cooling)

The Administrative Record includes several references for this evaluation of alternative technologies, including:

- a. Duke Energy's *Morro Bay Power Plant Modernization Project 316b Resource Assessment Report*, July 10, 2001.
- b. USEPA information for the new and proposed 316(b) regulations, including USEPA's Phase II Technical Development Documents.
- c. *Preliminary Regulatory Development, Section 316(b) of the Clean Water Act, Background Paper Number 3: Cooling Water Intake Technologies*, 1994 (hereafter Background Paper No. 3).
- d. *Fish Protection at Cooling Water System Intakes: Status Report*, Electric Power Research Institute, 1999 (hereafter EPRI 1999).
- e. California Energy Commission staff's *Final Staff Assessment*, April 2002.
- f. California Energy Commission's Presiding Members Proposed Decision, November 2003.
- g. Tetra Tech's (the Regional Board's independent consultant) *Evaluation of Cooling System Alternatives: Proposed Morro Bay Power Plant*, May 2002.
- h. Tetra Tech's memo to the Regional Board regarding salt drift from saltwater cooling towers, October 22, 2002.

Intake Structure Technologies (Screens, Filters)

Intake structure technologies are evaluated in detail in Background Paper No. 3. This report was prepared by Science Applications International Corporation (SAIC), an independent consultant to the EPA. The EPA suggests that agencies use Background Paper No. 3 when implementing section 316(b) of the Clean Water Act. Background Paper No. 3 describes all potential intake structure technologies, including ten types of intake screens and five types of passive intake systems.

Background Paper No. 3 includes a description of each technology and corresponding Fact Sheets that describe where the technology is being used (if it is being used), advantages and disadvantages, research findings, and design considerations. The conclusions of Background Paper No. 3 are summarized below.

Screens: Regarding intake screen systems, Background Paper No. 3 states: "The main finding with regard to intake screen systems is that they are limited in their ability to minimize adverse aquatic impacts." The report also states that "there has also been an interest in the use of fine-mesh mounted on traveling screens for the minimization of entrainment. However, the use of fine-mesh mounted on traveling screens has not been demonstrated as an effective technology for reducing mortality of entrainment losses." This is an important issue. Both once-through cooling and screening technologies cause mortality of organisms. The net benefit of a screening technology must be measured as a reduction in overall mortality. If the screening technology prevents entrainment of larvae and eggs, but simply replaces entrainment mortality with screening induced mortality, there is no benefit. The screening technologies are currently experimental. Site-specific and species-specific research must be done to determine their potential effectiveness at a particular power plant.

With respect to passive screens, Background Paper No. 3 concludes: "The main findings for passive intake systems are that available technologies that effectively reduce fish eggs and larvae entrainment are extremely limited." Radial wells and wedgewire screens are the only alternatives considered to have potential for reducing entrainment mortality. Radial wells are not used on large scale systems

such as MBPP. Radial wells are literally ground water wells, and are used on small-scale applications. Wedgewire screens are also limited in their application to facilities in rivers systems.

A comprehensive review of intake technologies is also provided in EPRI 1999. EPRI is the Electric Power Research Institute, Inc., of Palo Alto, California. Utility companies fund EPRI, which in turn sponsors research on utility industry issues. The conclusions of EPRI 1999 are similar to the conclusions of Background paper No. 3, that is, more research is needed on the various intake structure technologies before their applicability can be determined.

The Regional Board concurs with the conclusions of Background Paper No. 3 and EPRI 1999. The data collected on intake technologies to date are limited, highly variable, site-specific, and species-specific. The only technologies that may apply to MBPP for the purpose of reducing entrainment mortality are certain screening technologies, such as fine mesh screens, but they are considered experimental. A major problem with fine mesh screens is biofouling and mortality of larvae that are impinged on the screen. It is also difficult to determine the survivability of larvae that are impinged and then washed off the screens. Tetra Tech reports that survival rates for impinged larvae varies greatly based on studies at other facilities. The 316(b) demonstration report also discusses highly variable survivability (or mortality) results from studies done at other facilities. The only way to determine the effectiveness of a screening technology at MBPP is to conduct site-specific research, with independent scientific experts overseeing all aspects of the work. Such research would likely take years to complete, and the total costs are unknown, but would likely be in the tens of millions dollar range. The Regional Board concludes that fine mesh screen technology is not a demonstrated "available" technology for MBPP at this time.

Filter Technology: Tetra Tech 2002 concludes that the aquatic filter-barrier technology is experimental at this time. There are no known applications in a marine environment such as Morro Bay, and there are major concerns with biofouling and reliability. There are also major physical restrictions in Morro Bay Harbor that make this technology highly questionable. Regional Board staff met with several other agencies to assess the likelihood of a large filter barrier structure being approved for Morro Bay Harbor, and the response was negative. Duke Energy would likely have to obtain permission to use existing pier structures in the Harbor to physically support a filter barrier system. As with fine mesh screens, a research project would be necessary to evaluate this technology in Morro Bay.

Intake Structure Location: The location of the intake structure in the vertical water column is not an issue here because the water is relatively shallow. Changing the vertical location of the intake opening would not minimize the loss of larvae. The location of the intake structure for the proposed Power Plant is the same as for the existing plant, near the mouth of the Morro Bay Estuary. Moving the intake structure further into the Estuary is not a practical option because such a move would likely increase estuarine larval losses. The only other location for the intake structure is several thousand feet offshore. Changing the location of the intake structure to an offshore location would reduce estuarine taxa losses but would increase coastal taxa losses due to entrainment and impingement. In this case there are major problems with offshore fish species, including ground fish populations that are near collapse. An offshore intake location is discussed further under "Other Technologies" below.

Closed Cooling Systems

The greatest "minimization" of adverse environmental impacts to the Morro Bay Estuary would be obtained by a closed cooling water system. Most new power plants in California are using, or are planning to use, closed cooling technology. There is no question that closed cooling systems are established technologies for minimizing entrainment impacts. However, this 316(b) analysis must determine if closed cooling systems are available for use in Morro Bay considering the site-specific conditions for this project. If a cooling technology for the modernized Power Plant cannot be installed, that technology is not available. Also, the Board does not have authority to mandate

construction of an alternative cooling system. However, the Board can direct reduction in capacity of the intake system so as to necessitate construction of an alternative cooling system, if such a system is available based on a site-specific analysis. (USEPA, General Counsel Opinion No. 41, June 1, 1976, USEPA can limit the capacity of the intake but cannot mandate construction of cooling towers.)

Closed cooling systems are of two main types: wet and dry. Wet cooling systems recirculate fresh or saltwater through towers. Make-up water is needed to replace losses due to evaporation. Dry cooling systems recirculate fresh water in a truly closed system (like the radiator in an automobile); no evaporation occurs and therefore no makeup water is needed. These systems follow the general hierarchy below:

Closed Cooling Systems

- I. Wet Cooling (saltwater or freshwater)
 - a. Mechanical Draft Cooling Towers
- II. Dry Cooling
 - a. Air Condensers
- III. Hybrid Cooling (saltwater or freshwater)
 - a. Mechanical Draft Towers and Air Condensers Combined

Availability of Wet Cooling Systems

In a mechanical draft system, heated water from the power plant is pumped to the top of cooling towers where it is then sprayed downward inside the tower. Air is forced upward through the tower by large fans (this makes them “mechanical draft”). The forced air transmits heat from the water to the atmosphere. The cooled water collects at the bottom of the tower where it is recirculated back to the power plant. Some water is lost to evaporation, and “make-up” water is needed to keep the volume constant. Mechanical draft towers using fresh water are the most common cooling systems, and are being installed on the majority of new power plants in California (Staff Report, July 1, 2001). Mechanical draft cooling towers can be designed to handle all or part of the cooling load.

Mechanical draft towers using fresh water could theoretically reduce cooling water withdrawal from the Estuary to zero; however, there is very little fresh water available in the Morro Bay area. Regional Board staff estimates that approximately 8 to 10 MGD of make-up water would be needed based on the reports referenced above. The potential sources of fresh water would be the Morro Bay wastewater treatment plant (1.6 MGD average flow) and desalination plant (0.6 MGD). The amount of fresh water potentially available is therefore approximately 1.6 to 2.2 MGD (City of Morro Bay NPDES permit Order Nos. 94-03 and 98-15). Further, the City of Morro Bay would have to upgrade its wastewater treatment plant to tertiary level treatment, and then be willing to provide the fresh water to Duke Energy instead of using the water for other purposes. The City of Morro Bay would also have to be willing to provide desalinated water to Duke Energy instead of using it for other municipal purposes. This is highly unlikely in an area where fresh water supplies are very limited, and considering that the City of Morro Bay has adopted resolutions against the use of closed cooling systems for this facility. In any case, the amount of freshwater water potentially available is not adequate to operate fresh water wet cooling towers for the proposed Power Plant. Therefore, fresh water mechanical draft cooling towers are not currently available for use in Morro Bay for the proposed Power Plant. In addition, use of fresh water for cooling would be inconsistent with State Water Resources Control Board (State Board) Resolution No. 75-58, Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Power Plant Cooling.

Mechanical draft towers that use saltwater could reduce cooling water withdrawals from the Estuary by up to about 90%, depending on the design of the system. The Power Plant is located in the town of Morro Bay, just upwind of the downtown area (prevailing winds are from the northwest and the downtown area is to the southeast). With drift abatement technology installed, salt water cooling towers would produce about 60 pounds of salt drift per hour (about five tons per week, or 262 tons per year),

which would settle out over the community of Morro Bay directly downwind of the Power Plant (Tetra Tech memo to the Regional Board, October 30, 2002). Unlike nitrogen oxide and sulfur oxide or other gasses emitted from the Power Plant that spread out over thousands of square miles, salt drift is heavier and settles within a short distance of the cooling tower structure. Given the location of the modernized Power Plant relative to the community of Morro Bay, the prevailing winds, the amount of salt drift produced, and the City of Morro Bay's resolution prohibiting closed cooling systems for this facility, mechanical draft towers using saltwater are not available at this location. The City of Morro Bay's resolution determines that closed cycle cooling systems would violate various laws, regulations, and City ordinances (Note: The Resolution specifically addresses closed cooling systems proposed by Energy Commission staff, not salt water towers per se, but the land use, noise, and visual issues are the same).

Availability of Dry Cooling Systems

Dry cooling technology is similar to the cooling system in an automobile. Heated water is pumped from the power plant to a large external "radiator" or condenser. Large fans force air over the condensers and heat is thereby transferred from the condenser to the atmosphere. Dry cooling systems can be totally closed, requiring no make-up water. Dry cooling systems are currently in use at several power plants in the United States and are being included in plans for future power plant projects (Energy Commission Final Staff Assessment, April 2002). However, USEPA has found that dry cooling is not "best technology available" for new power plants on a national basis but might be feasible in limited cases based on site-specific circumstances (66 Fed. Reg. p. 65305, col. 3; USEPA has tentatively made the same determination for existing power plants 67 Fed. Reg. p. 17168.). In California and elsewhere, dry cooling is used where fresh water supplies are very limited.

Energy Commission staff concluded that dry cooling is feasible at Morro Bay (Energy Commission's Final Staff Assessment, April 2002). However, Duke Energy maintains that Energy Commission staff's conclusion is based on design parameters that do not support the proposed project. Duke Energy's proposed project would produce 1,200 MW across an ambient temperature range of 35° F to 85° F. The power plant analyzed by Energy Commission staff cannot achieve a power output of 1200 MW above an ambient temperature of 56° F (Duke Energy, February 15, 2002). This results in major differences between the size of the dry cooling units designed by Energy Commission staff and Duke Energy.

The dry cooling system for Duke Energy's proposed project would be twice the size of a dry cooling system for Energy Commission staff's design. The size of a dry cooling system is directly related to the cooling capacity needed, and Duke Energy's proposed design requires twice as much cooling capacity as the Energy Commission design. Energy Commission staff's dry cooling system would be 320 feet long x 206 feet wide x 100 feet high. Duke Energy's dry cooling system would be 640 feet long x 185 feet wide x 110 feet high. Duke Energy maintains that either of these systems are too large to fit on the property they own that is available for the modernized Power Plant.

Further, the City of Morro Bay adopted Resolution No. 20-02, finding that Energy Commission staff's proposed closed cooling systems would cause visual, noise, cultural, and land use impacts, and would not comply with many laws, ordinances, regulations, and standards, and that an Energy Commission override is not possible. For this reason alone, a dry cooling system is not currently available for the proposed project.¹

Either of these dry cooling systems (Duke Energy's or Energy Commission staff's) could add major noise, visual and land use impacts to the proposed project. Duke Energy, CEC staff, the Coastal Alliance on Plant Expansion, and the City of Morro Bay have established an extensive record regarding

¹ The Energy Commission has limited authority to override local laws. They can do so if they make a determination that a power plant that violates local laws is required for public convenience and necessity and that there are not more prudent and feasible means of achieving such public convenience and necessity. (Pub. Res. C. § 25525.)

these issues.

The Energy Commission's Revised Presiding Members Proposed Decision (PMPD) concludes that Energy Commission staff's design does not meet the objectives of the project, and after reviewing all the available evidence, concludes that dry cooling is not physically feasible or legal for the proposed project. The PMPD states the following:

1. The specific dry-cooling alternatives of [CEC] Staff and CAPE, fail to satisfy the requirement of CEQA that an alternative meet most of the key objectives of the project.
2. Closed-cycle cooling, including dry-cooling as proposed by [CEC] Staff and CAPE or adjusted in size to meet the objectives of the project, is not feasible at the Morro Bay site within the meaning of CEQA or the Clean Water Act.
3. For the purposes of exercising our responsibilities under the Warren-Alquist Act, we conclude that closed-cycle cooling does not constitute the "best technology available" for this power plant within the meaning of Clean Water Act section 316(b) because it is not feasible at this site and because the costs are wholly disproportionate to the benefits.

Availability of Hybrid Systems

Hybrid systems are simply a combination of dry and wet cooling technologies. The proportion of cooling assigned to each technology depends on site-specific conditions, such as the amount of make-up water available. A hybrid system that uses both dry cooling and fresh water mechanical draft towers would reduce cooling water withdrawals from Morro Bay to zero. A hybrid system that uses dry cooling and saltwater mechanical draft towers could reduce cooling water flows from Morro Bay by 95% or greater. However, hybrid systems use the same technologies discussed above (wet and dry systems), and therefore are not currently available in Morro Bay for the reasons noted above. The same issues apply to a hybrid system: overall size, visual, noise, and land use impacts, and the City of Morro Bay's Resolution No. 20-02. The City Resolution finds that the hybrid system proposed by Energy Commission staff would cause visual, noise, cultural, and land use impacts, and would therefore not comply with many laws, ordinances, regulations, and standards, and that an Energy Commission override is not possible.

Other Technologies

Natural Draft Cooling Towers: Natural draft cooling towers are discussed in the 316b Demonstration report. These towers work on the same principle as "mechanical" draft towers discussed above, except without "mechanical" fans. Without the mechanical fans, the natural draft towers must be much larger than the mechanical draft type towers. Natural draft towers would be so large (about 250 feet in diameter x 400 tall) that they cannot be seriously considered for the Morro Bay site. All the other obstacles mentioned above for other closed cooling systems also apply. This alternative is not an option at MBPP.

Reduced Flow: Cooling water pumps can be "single" speed or "variable" speed. All things being equal, a system using single speed pumps uses more cooling water than a system using variable speed pumps. Single speed pumps come on line as necessary to increase cooling water flow when power output increases. This results in an incremental stepwise increase in cooling water flow (316b Demonstration, page 6-94). Variable speed pumps may reduce cooling water flows in some cases by eliminating the stepwise incremental increase caused by an additional single speed pump coming on-line. Provision 8 of this Order requires Duke Energy to evaluate the cooling water flow reductions provided by variable speed pumps versus fixed speed pumps, and to install the most efficient type of pump if there is a significant difference (ten percent or greater).

Offshore Intake structure: The benefit of an offshore intake structure would be to decrease the impact to estuarine species. The disadvantage would be greater impingement and entrainment of nearshore (non-estuarine) fish species. The current Morro Bay Power Plant intake structure impinges about 1.4 tons of fish per year. For comparison, the Huntington Beach Power Plant, with flow volumes similar to the Morro Bay Power Plant, and with an offshore intake structure, impinges up to 21 tons of fish per year. The El Segundo Power Plant, also with flow values similar to Morro Bay Power Plant and using an offshore intake, impinges about 15 tons of fish per year. Both of the offshore intakes noted above are about 2000 feet offshore in about 35 feet of water. This information is from documents filed with the Energy Commission by the utility companies. It should be noted that fish return systems are available, such as the system used at the San Onofre Nuclear Generating Station (SONGS). A fish return system is a mechanical system that attempts to return impinged fish to their source water via a sluiceway. Overall, the SONGS fish return system results in a survival rate of about 68% for impinged fish, making the offshore intake structure more favorable. However, entrainment of offshore or coastal larvae cannot be reduced in an offshore intake system. Some of the offshore taxa that would be impinged and entrained in an offshore intake for the Morro Bay Power Plant are currently heavily impacted to the point of near collapse. The National Marine Fisheries Service recently implemented emergency “no-take” measures for certain species of rock fish, which may apply to an offshore intake structure. Entrainment of fish larvae is a major impact at SONGS; where modeling efforts predict substantial impacts on regional fish stocks due to entrainment of larvae in the offshore structure. In addition, the physical construction of an offshore intake system would cause major impacts to marine habitat. Therefore, an offshore intake is not a realistic alternative for minimizing adverse impacts because it would simply move the impacts offshore.

Seasonal Flow Limitations: Seasonal flow limitations are applicable in cases where one or more particularly important species (such as endangered or threatened species) are being entrained during specific times of the year. This is not the case at MBPP, where no threatened or endangered species were identified in the entrainment sampling program. At MBPP, larvae are available and entrained throughout different seasons, and seasonal flow limits would require choosing some species over others for protection. This alternative is required because there is no practical way to choose certain taxa as being more important than others unless there are threatened or endangered species present. The cost (lost revenue) of seasonal flow restrictions depends on the duration and magnitude of the seasonal limitation and energy prices. The costs could range into the millions per year depending on these factors. As noted above, there is no biological argument for seasonal flow limitations based on the species entrained. Therefore, this alternative is not reasonable at MBPP for reducing adverse impacts.

Cooling Ponds: There are two types of cooling ponds: “passive” and “spray.” Passive cooling ponds and spray ponds work on the same principle as mechanical and natural draft cooling towers. Warm water is exposed to the atmosphere and cooled, thereby releasing heat to the atmosphere. These systems are unconventional and no known application exists for a facility like MBPP, which is adjacent to the City of Morro Bay. Three circular “spray” type ponds would be necessary, measuring 620 feet in diameter [Duke Energy’s 316(b) Demonstration Report, 2001]. This amounts to about 20 acres of surface area. For “passive” type ponds, a surface area of 300 acres would be necessary. According to the Energy Commission’s PMPD, the available acreage for the entire modernized project is about 20 acres, so this alternative is not feasible.

Conclusion Regarding Availability of Alternatives

Alternatives to reduce entrainment are of two main types: intake structure technologies (screens and filters) and closed cooling (cooling towers, dry cooling). The Regional Board evaluated these alternatives and determined that screens and filters are experimental technologies at this time and are therefore not available for the MBPP project. Closed cooling alternatives are not available for the MBPP project due to legal, noise, visual, and physical issues. The Energy Commission’s PMPD evaluates all

available evidence and reaches the same conclusion (that is, the Presiding Commissioners overrode CEC staff on this issue). The Regional Board does not have jurisdiction to order Duke Energy to change its proposed project. Section 316(b) only allows the Board to regulate the intake structure and does not authorize the Board to order a change in the plant itself (see USEPA, General Counsel Opinion No. 41, June 1, 1976; see also, Water Code Section 13360). The Energy Commission also lacks the authority to order Duke to build a smaller power plant. (Pub. Res. C. § 25009.)

Similarly, Porter-Cologne requires a new or expanded coastal power plant to use seawater for cooling to use “the best available site, design, technology, and mitigation measures feasible” to minimize the intake and mortality of all forms of marine life. (Wat. Code §13142.5(b).) Section 13142.5 does not require consideration of cooling by other means than the intake of seawater. (State Board Order No. WQ 79-23.) Like Section 316(b), this section does not allow the Board to order a change in the plant itself, since the Regional Board cannot specify “the design, location, type of construction, or particular manner” for compliance with waste discharge requirements. (Wat. Code §13360.) As in the 316(b) analysis, the Regional Board’s role is limited to determining whether the proposed project, together with any proposed mitigation measures, satisfies Section 13142.5.

The State Board has only considered Section 13142.5(b) in two orders, both involving the same offshore liquid natural gas facility. (State Board Orders Nos. WQ 79-23, 79-34.) In the first order, the State Board ruled that the discharger could not commence construction of the seawater intake system until it presented sufficient evidence on which the Regional Board could base the Section 13142.5(b) findings. The State Board did not condition construction of other parts of the facility on this finding. In the second order, the State Board found that changes to proposed intake system were adequate under Section 13142.5(b), without considering alternatives for the *facility*. Although the State Board did not directly address this question, the orders suggest that Section 13142.5 findings should address whether the intake structure (not the facility itself) includes the best available site, design, technology, and mitigation measures feasible.²

Therefore, in analyzing best technology available for the intake structure, the Regional Board considers only the modernized Power Plant proposed by Duke in its application for this Order. **[Note: this will be updated based on the final EPA regulations]** However, this Order requires Duke Energy to evaluate and install the most efficient type of cooling water pump, and to minimize cooling water flows by shutting down cooling water pumps when possible. Additionally, periodic dredging at the intake may decrease intake velocities to reduce impingement. No other available technologies involving the location, construction or capacity of the cooling water intake structure for the proposed project would minimize environmental impacts, intake or mortality.

WHOLLY DISPROPORTIONATE COST TEST

Legal Background

EPA interpretations of section 316(b) have consistently implemented a “wholly disproportionate” cost test as established in a 1977 Decision of the Administrator. (*Public Service Company of New Hampshire, et al. Seabrook Station, Units 1 and 2*, (June 10, 1977 Decision of the Administrator) Case No. 76-7, 1977 WL 22370 (E.P.A.) “*Seabrook I.*”) In *Seabrook I.*, the EPA Administrator ruled that EPA was not required to perform a cost/benefit analyses when applying section 316(b) on a case-by-case basis. However, the Administrator reasoned that cost must be considered otherwise “the effect would be to require cooling towers at every plant that could afford to install them, regardless of whether or not any significant degree of entrainment or entrapment was anticipated.” (*Id.* pp. 6-7.) The Administrator ruled “I do not believe it is reasonable to interpret Section 316(b) as requiring use of technology whose cost is wholly disproportionate to the environmental benefit to be gained.” The

² Mitigation measures are discussed below.

“wholly disproportionate” test was affirmed by the federal First Circuit Court of Appeals in *Seacoast Anti-Pollution League v. Costle* (1st Cir. 1979) 597 F.2d 306.)³

The First Circuit Court clarified the “wholly disproportionate test” was one of incremental cost. The Court stated: “[t]he Administrator decided that moving the intake further offshore might further minimize the entrainment of some plankton, but only slightly, and that the costs would be ‘wholly disproportionate to any environmental benefit’.” (*Id.* at 311.) The wholly disproportionate test has continued to be used by EPA when applying section 316(b) since the *Seabrook I* decision. It does not appear in the 1977 Draft Guidance because that document was issued in May 1977 before the *Seabrook I* ruling.

While EPA has continued to use the wholly disproportionate test, there does not seem to be any consistency in how the test is used. In *Seabrook I*, the Administrator considered various construction/design alternatives and the alternative to locate the intake offshore. Concluding that these alternatives would provide minimal environmental benefit, the Administrator rejected them. The First Circuit Court of Appeals affirmed that the cost of the offshore outfall location was wholly disproportionate to this minor additional minimization of entrainment.

When EPA drafted the New Plant Final Rule, it determined that closed-cycle cooling was best technology available for all new facilities but provided for site-based alternatives justified by use of alternative technologies and restoration projects. (66 Fed. Reg. 65314, cols. 2-3; 65315 cols. 1-2.). Nonetheless, the New Plant Final Rule preserves a form of the wholly disproportionate test. It provides that if the discharger demonstrates that facility-specific data shows the cost of compliance would be wholly disproportionate with costs considered by EPA when establishing a compliance requirement, a less costly alternative may be permitted. (40 C.F.R. § 125.85(a).)

Application of the Wholly Disproportionate Test to MBPP

A wholly disproportionate cost test compares the cost of technology alternatives to the benefit to be gained by implementing alternatives. The EPA provides information on entrainment valuation methods in their supporting documentation for the proposed 316(b) rule for existing facilities. The valuation methods basically attempt to put a dollar value on entrainment losses. EPA acknowledges that this is a difficult process because there are few actual values, such as commercial fishing values, associated with entrained larvae. Assumptions must therefore be made about larval losses that have no inherent or definable economic value. These assumptions can vary greatly depending on professional opinions, such that the resulting values can vary by orders of magnitude (staff report for Diablo Canyon Power Plant NPDES permit renewal, July 10, 2003). The Regional Board is aware of the difficulty inherent in placing a value on entrainment losses and uses a reasonable, common sense approach based on the actual conditions of the affected ecosystem.

Habitat Valuation

The habitat valuation approach converts the proportional larval loss values to habitat acreage. The acreage values can then be converted to dollars for the purpose of setting up a dedicated account to fund habitat restoration and preservation. This approach is not intended to imply a loss of habitat, or the need to create additional habitat. This approach estimates how many acres of habitat it would take to offset the larval loss caused by the Power Plant. The habitat valuation acreage is estimated by using

3. *Seabrook I* was appealed and remanded based on procedural grounds. (*Seacoast Anti-Pollution League v. Costle*, 572 F.2d 872.) On remand, the Administrator cured the procedural flaws and readopted all the findings in *Seabrook I*. (*Public Service Co. of New Hampshire, et al. v. Seabrook Station Units 1 and 2* (August 4, 1978 Decision of Administrator.) The Court of Appeal in *Seacoast Anti-Pollution League v. Costle*, 597 F.2d 306, cited in text above, affirmed the Administrator’s decision on remand.

the 10% (Duke Energy's estimate) to 33% (Regional Board staff estimate) larval loss range described above for estuarine species. Assuming the Morro Bay Estuary is 2300 acres in size, the equivalent habitat value range is calculated as: $0.10 \times 2300 = 230$ acres, and $0.33 \times 2300 = 759$ acres. The equivalent habitat value range is then 230 to 759 acres of estuarine habitat. This approach is a reasonable method for determining the value and importance of the proportional larval loss. This approach is not intended to indicate a requirement to restore such habitat. The above calculation uses the entire wetted surface area of the Morro Bay Estuary (2,300 acres) to convert the larval losses to habitat acreage. This may result in an overestimate of the acreage that would be required to produce the larval losses. The reason for this is that most entrained organisms use only a portion of the Morro Bay Estuary. If that portion were known (and it was less than 2,300 acres), it would be used in the equation and the result would be a smaller amount of habitat (less impact). Since the actual amount of habitat used by entrained organisms is unknown, we use the entire Estuary in the calculation.

To determine the dollar value of a habitat enhancement fund, we can convert the acreage values to dollar values by using land cost and restoration cost estimates relevant to the Morro Bay Estuary area. Regional Board staff contacted the Morro Bay National Estuary Program office to obtain these estimates.

1. Based on actual costs of a riparian area restoration project conducted by the Resource Conservation District (restoration of a floodplain for sediment capture and revegetation), a rough estimate for similar work would be \$18,000 to \$20,000 per acre. This does not include land purchase costs.
2. The Coastal Conservancy suggested using an estimate of \$20,000 per acre for riparian type restoration costs.
3. The Morro Bay National Estuary Program, along with other partners, is investigating the purchase of parcels in the watershed for sediment capture and riparian habitat restoration. While land values vary considerably depending on location, size, and other factors, a reasonable estimate for upland acquisitions (such as combinations of grazing land, cultivated land, and riparian corridors) is about \$10,000 per acre. This estimate is for purchases only, not restoration.
4. Acquisition costs closer to the Estuary and the town of Los Osos can be higher. The Morro Bay National Estuary Program recently participated in the purchase of a site adjacent to Loss Osos Creek for about \$55,000 per acre. Another property further upstream is under option to purchase with an appraised value at \$37,500 per acre. These values are for purchase only and do not include restoration costs.

These estimates do not include the very high value of shoreline residential real estate, which can be several hundred thousand dollars per acre. Obviously, there is a great deal of variability in costs for acquisition and restoration of habitat. The Army Corps of Engineers recommends using \$100,000 per acre for restoration and purchase costs based on projects in Southern California where costs are very high. Extremely high costs can be found, such as the San Onofre Nuclear Generating Station (SONGS) wetlands mitigation project in Southern California. The Coastal Commission required Southern California Edison to create 150 acres of wetlands to mitigate impacts caused by the SONGS cooling water system. The cost for the mitigation project is reportedly over \$100,000 per acre. These high costs should not be used as a realistic reference for Morro Bay because they represent major habitat creation or restoration and/or high property value areas. The Regional Board considers cost estimates based on local projects to be more realistic and reasonable.

Therefore, reasonable costs for local, simple habitat restoration appear to be about \$20,000 per acre. A reasonable range for acquisition costs appears to be \$10,000 to \$55,000 per acre. Using a middle value of \$30,000 per acre, the dollar value range from the habitat valuation approach is calculated as: $230 \text{ acres} \times \$30,000/\text{acre} = \$6.9 \text{ million}$, and $759 \text{ acres} \times \$30,000/\text{acre} = \$22.8 \text{ million}$. The dollar values are then \$6.9 million or \$22.8 million depending on the method used to arrive at a larval loss

estimate. These values are not intended to be exact, but are intended to indicate general values for entrainment losses depending on the larval lost estimate assumed (10% or 33%).

Sedimentation Reduction Valuation

Another approach is to consider the condition of the Morro Bay Estuary and cost associated with protecting the Estuary over the long term. It is well established that the Morro Bay Estuary is losing estuarine habitat volume at an exponential rate. The Morro Bay National Estuary Program's Comprehensive Conservation Plan for the Morro Bay watershed describes sedimentation as the primary threat to the Morro Bay Estuary. In addition, the sedimentation problem is described in the Regional Board's Sedimentation Total Maximum Daily Load (TMDL) Order for the Morro Bay watershed. (Order No. R3-2002-0051, adopted May 16, 2003; see 23 Cal. Code of Regs. §3925.). The TMDL Order estimates sediment loading from various land categories (ranchland, irrigated agriculture, brushland, etc.), sets a sediment load reduction goal of 50%, estimates the cost of achieving the goal at approximately \$13 million using best land management practices, and includes a monitoring program to measure sedimentation reduction success.

As part of the preparation for this Order, the Regional Board retained an independent expert in physical estuarine dynamics, Jeff Haltiner of Philip Williams and Associates (PWA), to review the existing information on sedimentation and estuarine longevity and provide an independent analysis to the Regional Board. The PWA report to the Regional Board is titled *Morro Bay Sedimentation: Historical Changes and Sediment Management Opportunities to Extend the Life of the Bay*, August 2002. The PWA report verifies that estuarine volume is being lost at an accelerated rate due to accelerated upland erosion. Overall, the majority of estuarine volume will be lost within about 400 years. The back Bay volume will be lost within 100 years. This loss of estuarine volume is a loss of physical habitat, and estuarine habitat is a non renewable resource.

PWA estimates that a 50% reduction in sedimentation will double the life of the estuary. This is equivalent to a gain of several hundred thousand acre-years of habitat productivity. "Acre-years" is a unit that represents estuarine productivity over time, which can be compared to the benefit of closed cooling system in like units. New habitat is not created with sedimentation reduction, but existing estuarine habitat (or wetland habitat) is prevented from being lost, thereby extending the life of the Estuary. Note that estimating the life of the Estuary depends on the reference elevation chosen, as discussed in the PWA report. The higher the reference elevation chosen to represent the "full" level, the longer it takes for the Estuary to fill in. In a previous staff report to the Regional Board (May 2002), the benefit of sedimentation reduction was presented in acres-years. Using PWA's estimate that a 50% percent sedimentation rate reduction doubles the overall life of the Estuary from 400 to 800 years, the gain in habitat productivity for all habits would be approximately $(400 \text{ years} \times 1,725 \text{ acres})/2 = 345,000$ acre-years of additional estuarine productivity. Note that the Estuary is 2,300 acres in size, but an area of 1,725 acres is used in this calculation because the harbor area (Zone 1 in the PWA report) is excluded due to regular dredging. This overall gain of about 345,000 acre-years of estuarine productivity occurs over an 800-year period (doubling the life of the Estuary from 400 to 800 years, but benefits occur from zero to 800 years).

PWA's memo to the Regional Board, October 24, 2002, further refines the estuarine volume loss estimates to reflect the habitat utilized by entrained taxa, i.e., the habitat below the +4.68 feet Mean Low Lower Water (MLLW). The estuarine volume below this reference elevation is "critical habitat" to fish and invertebrates entrained by the Power Plant. Without this habitat, the estuarine taxa entrained by the Power Plant would not exist. This focused analysis by PWA allows a more detailed evaluation of habitat critical to entrained organisms and may help prioritize projects such that this critical habitat and is discussed further in Regional Board staff testimony for this Order.

Similar to the Regional Board's sediment TMDL for the Morro Bay watershed, PWA identifies the

sources of erosion, land treatments that would reduce erosion, and costs. PWA's October 24, 2002 memo to the Regional Board estimates costs for sedimentation reduction efforts (referred to as "treatments" in the PWA report). PWA provides sediment trapping capacity and cost estimates for the following sediment reduction practices throughout the Morro Bay watershed, listed in order of their effectiveness in reducing sedimentation:

Vegetative Buffers
Sediment Traps
Stream Channel Restoration
Floodplain Restoration
Grazing Management
Crop Management
Road Decommissioning
Prescribed Burns
Post Fire Management
Construction Best Management Practices

PWA estimates that a sediment reduction of 42% to 52% could be achieved by implementing these actions, at a cost range of \$12 million to \$25 million. Approximately 80% of the costs are for the first four sediment reduction practices listed above. Therefore, for a cost range of \$12 to \$25 million, the benefit is 345,000 acre-years of productivity over 800 years.

Since sediment reduction will result in significant benefits to the taxa entrained by preserving habitat critical to these species, a Habitat Enhancement Program is a viable alternative for the modernized Power Plant project under section 316(b).

Duke Energy also submitted a Habitat Enhancement Program report to the Regional Board (Duke Energy, August 2002). Duke Energy's proposal has four main objectives:

1. Offset and minimize the effects of entrainment of the modernized plant;
2. Improve the quality and quantity of aquatic habitat in Morro Bay;
3. Reduce sediment transport into Morro Bay; and
4. Complement ongoing Bay protection and enhancement programs overseen by the Regional Board, the Morro Bay National Estuary Program (MBNEP), and the Army Corps of Engineers (ACOE).

Duke Energy proposes a funding level of \$12.5 million for implementing sediment reduction and estuarine habitat restoration projects. Duke Energy's report evaluates the benefits of projects differently than the Regional Board. However, the project examples evaluated by Duke Energy are from PWA's report to the Regional Board. Regardless of the method used to evaluate the benefit of certain projects (Duke Energy's method or Regional Board's method), the projects that need to be implemented to protect and preserve the Morro Bay Estuary remain the same, as defined in the PWA report. Duke Energy's Habitat Enhancement Program proposal is discussed further in Regional Board staff testimony for this Order.

The costs estimates in Table 2 below are from Tetra Tech's independent report to the Regional Board (Tetra Tech, 2002), the Energy Commission's PMPD, and Duke Energy. The PMPD finds that Duke Energy's cost estimates are the most realistic estimates. The Energy Commission's PMPD concludes that Duke Energy's cost estimates are the most reliable. The reports referenced above should be consulted for details on engineering designs, layouts, and line item costs. Tetra Tech's report to the Regional Board is available on the Regional Board's website (<http://www.swrcb.ca.gov/rwqcb3/Facilities/DukeEnergy/DukeMB.htm>). Cost estimates for

experimental systems, such as fine mesh screens and the aquatic filter barrier are not included because they are considered experimental technologies at this time.

TABLE 2: Cost Estimate Comparisons for Alternatives.

Alternative	Duke Energy Total Present Value	Tetra Tech Total Present Value May 2002	CEC PMPD Total Present Value November 2003
Salt Water Mechanical Draft Cooling Towers	\$165 million or amortized at \$13 million per year for 30 years (June 2001)	\$28+ million or amortized at \$2.5 million per year for 30 years	Not Done (salt water towers not feasible)
Dry Cooling	\$163 to \$253 million. (Total Present Value)	\$105 million or amortized at \$9.3 million per year for 30 years	\$163 to \$253 million, based on Duke Energy's estimate. (Total Present Value)
Hybrid Wet/Dry Systems	\$171 to \$261 million (Total Present Value)	\$98 million or amortized at \$8.6 million per year for 30 years	\$171 to \$261 million, based on Duke Energy's estimate (Total Present Value)

The benefit of a closed cooling system is elimination of larval losses. As explained above, the modernized Power Plant would entrain 10% (Duke Energy's Estimate) or 33% (Regional Board staff's Estimate) of those larvae subject to entrainment in the Morro Bay Estuary. This larval loss can be expressed in acre-years of productivity to better illustrate the cost/benefit comparison. From above, the larval loss due to entrainment converts to a range of 230 to 759 acres, and this result may be a conservative estimate of impact in terms of habitat acreage (erring on the side of overestimating the impact).

The modernized Power Plant may operate for about 50 years (based on the longevity of the existing Power Plant). Therefore, the larval productivity loss over the operational life of the modernized Power Plant is (230 acres x 50 years) or (759 acres x 50 years) = 11,500 acre-years or 37,950 acre-years of lost larval productivity. Rounding off, the range is 12,000 acre-years or 38,000 acre-years. Installation of a closed cooling system would therefore provide a benefit of 12,000 or 38,000 acre-years of larval productivity over the 50-year life of the power plant. The cost and benefit of a closed cooling system can then be compared to the cost and benefit of sedimentation reduction projects using the same units (acre-years).

<u>Alternative</u>	<u>Cost Range</u>	<u>Benefit</u>
Closed Cooling Systems	\$28 to \$261 million	12,000 or 38,000 acre-years over 50 years
Sediment Reduction	\$12 to \$25 million	345,000 acre-years over

800 years

The benefits of these alternatives are not realized in the same time frame. The benefit of closed cooling is realized over the 50-year life of the modernized Power Plant. The benefit of sediment reduction is realized over hundreds of years. In addition, sediment reduction will benefit the entire estuary, including hundreds of species that are not entrained, and will benefit water quality by reducing pollutant loading (benefits that cannot be estimated). A 50% reduction in sedimentation rates will double the life of the estuary, and the overall ecological benefit will be a gain of about 345,000 acre-years of estuarine habitat productivity. The costs of closed cooling are therefore wholly disproportionate to the benefit to be gained when compared to the cost and benefit of sediment reduction over time.

The cost range listed above for a sediment reduction projects (\$12 to \$25 million, from the PWA report) is similar to habitat enhancement cost ranges (\$6.9 to \$23 million) discussed on page 18, above (using a different approach to value the entrainment losses). Also, Regional Board staff presented another approach for estimating the "value" of entrainment losses as stated in previous staff reports to the Board (July 2001, May 2002). The approach discussed in these previous staff reports used USEPA national cost estimates for restoration projects, rather than actual numbers for Morro Bay projects, and arrived at a cost range of \$12 to \$16 million. These three cost ranges are based on different approaches, but have similar results, which indicate reasonable results. As part of the modernization project, Duke Energy submitted a Habitat Enhancement Program (August 2002) proposal to the Regional Board and the Energy Commission, which would provide \$12.5 million to fund habitat enhancement projects. Considering the conservative nature of the estimated impact (which acts to overstate the impact), Duke Energy's proposal is reasonable.

Availability of Sediment Reduction Projects

The PWA report discusses sediment reduction projects that could be implemented in the Morro Bay watershed, the relative degree of sediment reduction that could be achieved for different types of projects, and their relative costs. This PWA report is discussed in more detail in Regional Board staff's testimony for this Order.

Conclusion Regarding the Wholly Disproportionate Costs Test

The cost estimates for closed cooling systems range from \$28 to \$261 million (for systems that are not feasible at MBPP), and the benefit provided by closed cooling would be 12,000 or 38,000 acre-years of larval productivity depending on the larval loss estimate used. The cost estimate for producing 42% to 52% reduction in sedimentation ranges from \$12 million (42% sedimentation reduction) to \$25 million (52% sedimentation reduction). A fifty percent sedimentation reduction would provide a benefit of approximately 345,000 acre-years of overall estuarine productivity over a time period of 800 years. The time frames differ for realizing the closed cooling benefits versus the sedimentation reduction benefits. However, sedimentation control is a main goal of the Regional Board and the National Estuary Program, and is a valid resource protection effort. Further, the mission of the State and Regional Boards is to preserve beneficial uses for future generations. Therefore, the costs of closed cooling systems are wholly disproportionate to the benefit to be gained when compared to the costs and benefits of sediment control efforts. This comparison is valid because Duke Energy has included a habitat enhancement fund of \$12.5 million in the proposed project, and the need for sedimentation control has been firmly established by the Regional Board and the National Estuary Program.

Finally, the Energy Commission's PMPD also concludes that the costs of closed cooling are wholly disproportionate to the benefits that would be achieved when compared to habitat enhancement projects. The PMPD concludes that even if closed cooling were free, it would not offer the

environmental benefits to the Morro Bay Estuary that a successful habitat enhancement program would provide.

Conclusion Regarding the Requirement to Use the Best Available Mitigation Measures Feasible to Minimize Intake and Mortality

For the reasons discussed above, no feasible mitigation measures (screens, filters, or closed cooling systems) are available to minimize the intake and mortality of marine life. The habitat enhancement program will provide a benefit of 345,000 acre-years of overall estuarine productivity. No other feasible mitigation measures have been identified that provide this level of benefit. Therefore, the project, including the habitat enhancement program, will use the best available mitigation measures feasible to minimize intake and mortality.

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